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Elizabeth C. Losos, Ph.D. Sep 97  
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**International Cooperative Biodiversity Group  
Associate Program 1: Biodiversity Conservation**

**Annual Report for Cooperative Agreement DAMD17-95-2-5010  
September 15, 1997**

- Institution:** Center for Tropical Forest Science, Smithsonian Institution  
Man and the Biosphere Program, Smithsonian Institution  
Bioresources Development and Conservation Programme-Cameroon  
Bioresources Development and Conservation Programme, Nigeria
- Activities:** Establishment of large-scale Forest Dynamics Plot and series of  
Biodiversity Measuring and Monitoring Plots; Inventory and database creation;  
Training in biodiversity research and plot methodologies.

## **I. SCIENTIFIC RESULTS**

### **A. Scientific Summary**

During Year Two of AP1, the Center for Tropical Forest Science (CTFS) initiated the establishment of a large-scale Forest Dynamics Plot in the Korup National Park, Cameroon, and the Smithsonian Institution/Man and the Biosphere Program (SI/MAB) held courses in biodiversity research and monitoring and established a series of small-scale permanent tree plots in Cameroon and Nigeria. Training of local participants in gathering and analyzing biodiversity data has been an important component of both the CTFS and SI/MAB plot projects.

As illustrated in this report, the ICBG umbrella is providing a unique opportunity to link rigorous biodiversity data from large- and small-scale permanent forest plots with information on socioeconomic and ethnobotanical characteristics provided by AP2 and AP5 to design appropriate management and conservation strategies for medicinal and other commercially valuable forest species.

### **B. Research/Training Accomplishments**

#### **i. SI/MAB BIODIVERSITY COURSE AND SMALL PLOT SERIES**

SI/MAB held training courses in biodiversity measuring and monitoring in Cameroon and Nigeria. The Bioresources Development and Conservation Programme-Cameroon (BDCCP-C) and BDCCP in Nigeria, respectively, organized the in-country preparation for each of the two-week training courses. U.S. course experts, namely Dr. Francisco Dallmeier, Christopher Ros, and Dr. Alfonso Alonso in Cameroon and Dr. Dallmeier and Dr. James Comiskey in Nigeria, provided instruction on the methodology, which was demonstrated by field work involving course participants. Field techniques were taught through the establishment of a 1-ha plot in each country, within which all trees 4 cm dbh were measured and identified. The second half of each course included instruction in data entry, verification, and analyses. In Cameroon, three plots have been established in Campo and two in Mamfe (Ejagham Reserve). In Nigeria, three plots have been established, and two more are planned. In August 1997, SI/MAB, in cooperation with Terry Sunderland, who is coordinating the plot establishment and analyses, completed the document "SI/MAB Biodiversity Research and Monitoring Regional Course, Cameroon 1996." *Please see this publication for more detailed information on SI/MAB methodology and plot results, including flora and fauna inventories and analyses.*

## ii. CTFS FOREST DYNAMICS PLOT

Plot description and initiation: After a delayed start, the 50-ha Korup Forest Dynamics Plot (KFDP) in Korup National Park, Cameroon, is now running smoothly and making rapid progress. In accordance with CTFS methodology, every stem 1 cm diameter at breast height (dbh) is being mapped, measured, tagged, and identified. The plot is located in tropical evergreen forest at an elevation of 552 m above sea level. Generally the forest in which the plot is located has an unbroken canopy at ~15-25 m with scattered taller emergents, and the understory is dense with lianas (not included in the initial enumeration) and small stems. There are also some giant trees up to 2 m dbh. The KFDP site includes both low-lying swamp and hills rising to steep, rocky terrain, thus satisfying our goal to select a site which is heterogeneous in terms of soil type, aspect, topography, and vegetation type. The plot also meets the criteria that it be typical of the forest found in the area to allow for appropriate generalization of results.

In January 1997 field teams were selected, and Dr. D. Thomas (U.S. Technical Consultant), Dr. R. Condit (CTFS/STRI scientist), and Dr. N. Songwe (In-country Field Director) held training sessions at the plot site. In addition, field supervisors David Kenfack and Dr. George Chuyong received advance training in CTFS methodology at a special training session in the Democratic Republic of Congo (formerly Zaire). The training course was hosted by the Centre de Formation et de Recherche en Conservation Forestiere (CEFRECOP)/Wildlife Conservation Society, CTFS' partner in Congo. Becoming familiar with a complete large plot and receiving an introduction to the entire plot monitoring protocol proved highly valuable for the field supervisors and has contributed to the smooth operation of the plot to date. In addition, the interaction between the two CTFS African sites promoted inter-regional networking and institution building within both organizations.

Topographic survey and plot demarcation: The plot is 1000 m N-S with a total of 50 survey lines running E-W, numbered 0-49 (which correspond with 50 1-ha sub-plots, or columns). Surveying of the KFDP is proceeding from the mid-line of the plot and moving north. The survey team has been placing corner poles demarcating 20 m x 20 m quadrats. Between January - May 1997 an area of 12.32 ha was surveyed with 308 quadrats demarcated. The rate of surveying increased with the use of an improved survey compass and increased familiarity with surveying techniques. However, the heavy rains of the wet season necessitated the suspension of work until next dry season. The current goal is to complete surveying of the 50-ha plot by the end of the 1997-8 field season.

Enumeration: Enumeration of the plot was initiated with the placement of the first tag around an *Aulococalyx* sp. (Rubiaceae) on January 31, 1997. By the end of May 1997, 158 quadrats, or 6.32 ha, had been completed. The efficiency of the two initial teams has been impressive, particularly given that some of the sub-plots have more stems than our anticipated maximum of 7000 (7152, 7758, and 7508 for sub-plots 20, 21, and 22). More tags were created for their completion. In the 158 quadrats enumerated, a total of 43,622 stems have been tagged, measured (except for those with high buttresses) and mapped. Work will resume in late fall 1997, and, with the addition of two more teams, we estimate enumeration will be complete for the first 25 ha by the end of the 1997-8 field season.

Botanical program: The botanical identification program also began in January 1997. Dr. Duncan Thomas has provided training in identifications and specimen preparation, and Field Supervisor David Kenfack is coordinating the on-site program. At the end of June 1997, 86 of the 158 enumerated quadrats had also been checked for proper identification, coding, and omissions. The botany program has continued through the wet season with additional workers (four total).

Voucher specimens of unidentified species within the plots and replicates of fertile specimens in and around the plots are currently being collected and dried in an electric dryer at the KFDP headquarters. A field dryer at the chimpanzee camp is being constructed. During sorting of dry specimens, members of the enumeration team are trained by Mr. Kenfack in recognizing plant families and common species in the plot, and in coding the species. Mr. Kenfack will travel in September to the National Herbarium, Yaounde, for identification of specimens.

Initial identifications, carried out by Dr. Thomas, indicate that the first quadrat contains 326 individuals 1 cm dbh of 71 species. Using CTFS data from other tropical forests throughout the world, Dr. Condit estimated that density is quite high and diversity comparable to the flagship CTFS site in Panama. Using Fisher's alpha to extrapolate from these data, Condit estimated that 25 ha should contain approximately 180,000 trees of 250-300 species.

Data checking: During the wet season, data recorded for already enumerated sub-plots have been checked by a team led by Dr. Chuyong. Dr. Chuyong is checking diameter measurements, tree mapping, and data entry. Within each quadrat, 25% of the stems within one randomly chosen sub-quadrat are sampled and their diameters and coordinates re-measured. Six quadrats have been checked and appropriate statistical methods will be employed to evaluate significant differences and identify possible sources of error.

Status summary:

Topographic Survey	12.32 ha (308 quadrats)	
Enumeration	6.32 ha (158 quadrats)	43,622 stems tagged, measured, & mapped
Botanical program	3.44 ha (86 quadrats)	First quadrat: 326 individuals of 71 species
Data Checking	0.24 ha (6 quadrats)	

## MANAGEMENT ISSUES

### A. Administration

#### i. SI/MAB PLOTS

Summary (see SI/MAB report): At this time, the SI/MAB program is coordinating the completion of the 1-ha plot series in Nigeria. A document of proceedings and data results for the Nigeria regional course and plots will then be compiled in the same manner as that produced for the Cameroon course. This "user guide" will be replicated and distributed to participants in the course, the ICBG regional partners, and other appropriate interested parties.

#### ii. KORUP FOREST DYNAMICS PLOT

KFDP administration: In-country Field Director Dr. N. Songwe has submitted very informative and complete quarterly reports since inception of KFDP in January 1997. These reports are accompanied by statements of revenue and expenditures, original receipts, and monthly salary disbursement report, which are submitted by Julius Mbotiji, Project Assistant. These have also been very clear and have adhered closely to the projected expenses outlined by Dr. Thomas and Songwe at the initiation of the large plot in early 1997.

A series of adjustments concerning administration of the project funds in Cameroon continue to be made. An SI contract, signed in early 1997, established BDCP-C as our in-country partner and administrator of KFDP. With the agreement of BDCP-C, another SI contract was signed with Korup Project (KP) to carry out disbursement of field salaries and expenses. At the time it was recognized by all parties that BDCP-C did not have the capacity to disburse local KFDP expenses because of its remote location. KP, as the entity responsible for coordinating research in Korup National Park, has assisted our project by disbursing these funds from their existing Mundemba offices. However, both CTFS and BDCP-C now wish to fulfill the original intent of their partnership and to place full administration of all transferred funds, including those responsibilities now being carried out by KP, with BDCP-C. We are currently addressing critical questions of logistics, security issues such as safe-keeping and transportation of funds, and administrative procedures and duties which will be fulfilled in return for BDCP-C's current administrative fee. Building the capacity of BDCP-C to satisfy all administrative needs of KFDP has the double advantage of strengthening BDCP-C and eliminating administrative fees to KP. Until that time BDCP-C will continue to transfer to Korup Project those funds required for payment of field expenses.

KFDP camp and office: The KFDP field camp is located at chimpanzee camp 1 km north of the plot. A large dormitory for 20 people, a dining hut, a kitchen and pit toilet have been constructed of wood and three previously existing wooden huts of the camp are also being used. A local dryer for specimens is being constructed as an attachment to the kitchen.

A small apartment in Mundemba serves as headquarters for KFDP. Four rooms are used as a general office, store, guest room, and kitchen. During the wet season, KFDP activities have been based here.

Equipment: Vehicle. The project vehicle, a Toyota Land Cruiser, diesel 4.2 liter, has been in use at KFDP since January 1997. Tax-free importation was provided by World Wildlife Fund until BDCP-C is able to transfer ownership. The vehicle is also available for use by AP2 and AP5, and we will increase coordination efforts to make the vehicle more accessible in this capacity in the coming year.

*Computers and office machines.* In fall 1997, Dr. Losos and Dr. Thomas will bring two computers to KFDP for use in data entry and finances, and one to BDCP-C to facilitate their administrative responsibilities. KFDP headquarters will also receive a durable inkjet printer and a desktop photocopier to duplicate field data sheets and printed material. This equipment will remain with BDCP-C at the completion of the ICBG project.

Site visit by U.S. Ambassador: On March 19-20, 1997, we were honored to have the U.S. Ambassador to Cameroon and several Cameroonian ministry officials gather at KFDP for an inauguration ceremony of the project. In attendance were His Excellency Charles Twining; Dr. Jean Blaise Nyobe, Director of Scientific and Technical Research, Ministry of Scientific and Technical Research (MINREST); Dr. David Mbah, Director of Valorisation and Development Support, MINREST; Augustine Bokwe, Technical Advisor No. 1 to the Minister of Environment and Forestry; Dr. Jato, then-President, BDCP-C; T. Tata, Executive Secretary, BDCP-C; Dr. Andrew Allo, World Wildlife Fund; Victor Balinga, Project Manager, The Korup Project; and Z.E. Akum, Park Adviser. Drs. Songwe and Thomas worked with BDCP-C to organize the event and were also present along with senior members of the KFDP field team.

During an evening ceremony at the KFDP field camp in the middle of the forest, the Ambassador attached the first honorary tag to a tree. The Ambassador and Cameroonian officials expressed enthusiastic support for the project, and the visit was described in a U.S. Department of State report.



## **B. Methodologies**

Why are two different types of plots included in the biodiversity component of the ICBG? The reason is that monitoring biodiversity in the tropics— that is, observing through time the ecological health of the forest community and species populations within it — presents a series of complications which require different methodological approaches to resolve. Two major obstacles to monitoring are, first, tropical forest may be comprised of many habitat types and, second, most tree species in the tropics are rare and occur at low densities.

SI/MAB is addressing the first case in Nigeria and Cameroon by gathering baseline data for a rapid index of the region's biodiversity. Because of the patchwork of vegetation types, monitoring must be done over a wide area in order to capture habitat variability. SI/MAB's methodology focuses on the inventory of larger trees ( > 4 cm) and some faunal taxa within a series of small (1.0 ha), long-term tree plots. These small plots are located across habitat types over a wide area to provide information on species-specific distribution, local extinction patterns, and community-wide changes in growth, mortality, and turnover.

The second problem with monitoring biodiversity has to do with species' rarity in tropical forests. In order to gain large enough samples for statistical and spatial analyses of species-specific parameters such as growth, mortality, distribution, and productivity in relation to biophysical factors, it is necessary to census plots of a much larger size than 1 ha. In addition, to understand forest regeneration, a study should census saplings and juveniles as well as adults. Such intensive sampling is very rare among permanent plot studies. With these needs in mind, CTFS focuses in great detail on flora (all woody stems > 1 cm) found within a single large plot. The Korup Forest Dynamics Plot in Cameroon is designed to monitor over 300,000 individuals of more than 300 tree species. We expect that over 100 individuals of at least half the species found in the 50-ha Korup plot will be sampled, providing sufficient data for rigorous statistical analyses. The CTFS methodology also called for KFDP to be situated in forest representative of the area to permit generalization of its results.

Both methodologies are relevant to the biodiversity monitoring needs of the ICBG program. In order to link drug development to appropriate conservation measures in Cameroon and Nigeria, adequate ecological profiles and distributions of commercially valuable species must be available. More specifically, data gathered by SI/MAB will provide the initial information on the habitat distribution and abundance of candidate species for drug trials. As drug screening and development proceeds, the large plot will be able to supply critical data regarding the determination of biologically sustainable harvest rates for selected plants with identified medicinal properties including detailed information on species abundance, size-distribution, productivity, regeneration, and spatial distribution.

Due to the large differences in scale of work, results from many of the small-scale SI/MAB plots are already available while completion of the fieldwork and analyses from the KFDP will take at least another year. To illustrate the magnitude of detail being studied, consider that the 1-ha plot at Dikolo Reserve, Cameroon, is monitoring about 1200 stems (> 4 cm), while at Korup we have already enumerated over 40,000 stems (> 1 cm) in only the first 6 ha of the plot.

## **C. Budget**

The attached Financial Report for AP1 runs from October 1, 1996 - July 31, 1997. The balance at the end of that period (including SI indirect costs) was \$28,058.31. However, additional obligated expenses amounted to \$36,266.14, which included travel expenses incurred by SI/MAB for the Nigeria course and funds obligated under the SI contract with Dr. Thomas. Thus AP1 had run out of available funds by mid-summer. The arrival of the Year Three installment (\$96,000) in August 1997 luckily averted a crisis. We are grateful to the Korup Project for advancing funds to KFDP to pay worker salaries and expenses for some two months after

project funds in Cameroon ran out in June. BDCP-C received a transfer of \$20,000 in August to reimburse KP and pay expenses through September, and another large transfer is being prepared as KFDP readies itself for a very active field season beginning in November 1997. In addition, about \$13,000 in approved back-expenses for the Cameroon course are also in the process of being reimbursed to SI/MAB.

From the inception of the ICBG grant through September 10, 1997, approximately \$115,000 of ICBG funds have been spent on the SI/MAB component and \$160,000 on the CTFS large plot component. Remaining expenses for SI/MAB in Year Four include replication and distribution of course user guides and completion of Nigeria plots (an additional \$13,000 total is allocated). Resources are now focused on the CTFS large plot. Under the current time-line, we expect that at the end of Year Four we will have completed surveying all planned 50 ha of KFDP and enumerating the first 25 ha. Completion of botanical identifications and data checking for the first 25 ha is scheduled for Year Five. However, these projections are based on adequate funding, and we have a shortfall of about \$40,000 for next year and \$8,000 the following year. If we were to complete the enumeration, identification, and rechecking for all 50 ha, we would have a further shortfall of about \$65,000 in Year Five. We are exploring options to minimize expenses as well as to leverage ICBG funding with additional funding from other potential sources.